SCIENCE

A WEEKLY JOURNAL DEVOTED TO THE ADVANCEMENT OF SCIENCE, PUBLISHING THE OFFICIAL NOTICES AND PROCEEDINGS OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

FRIDAY, MARCH 20, 1908

CONTENTS

MSS. intended for publication and books, etc., intended for review should be sent to the Editor of SCIENCE, Garrison-on-Hudson, N. Y.

THE AMERICAN SOCIETY OF ZOOLOGISTS

I.

THE fifth annual meeting of the Eastern Branch of the American Society of Zoologists, and the eighteenth since its establishment as the American Morphological Society, was held at the Sheffield Scientific School of Yale University on December 26, 27 and 28, 1907.

The following officers were elected:

President—William Morton Wheeler, American Museum of Natural History.

Vice-president—Herbert S. Jennings, Johns Hopkins University.

Secretary-Treasurer—Lorande Loss Woodruff, Yale University.

Member of the Executive Committee—Gilman A. Drew, University of Maine.

Eight investigators were elected to membership, making the total membership of the Eastern Branch 143.

The society voted to contribute 100 francs to the Lamarck Memorial Fund.

The following papers were presented:

Some Stages in the Life History of Hæmogregarina stephanowi, Danilewskya, of Turtle's Blood: C. W. HAHN.

This hæmosporidian was discovered by Danilewsky in 1885. Through the work of Saccharoff, Labbe, Langman, Simond, Börner, Siegel, Brumt and DuCloux we know that it is closely related to *Lankestrella minima* of the frog, which has been the subject of more extensive research. But the results of the investigation which is here reported go to show that the structure and life history of *H. stephanowi* can not be considered a very close parallel to

those of *L. minima* as described by Hintze (1902). We find a sexual generation made up of micro- and macrogametocytes with corresponding gametes, a zygote resulting from this conjugation, and a zygocyst with from 24 to 32 sporozoites, also an asexual generation arising from sporozoites and repeating itself again and again by schizogony, in which from two to twenty merozoites are produced. This cycle is completed entirely within the vertebrate host.

We have worked out a basis of relationship in the changes which the nucleus regularly undergoes after each division. It passes through about eight different structural conditions in its reconstruction, whether it be during the cleavage of the zygocyst, the schizont, or the gametocytes or in the growth of the gametocytes and schizonts. After division the nucleus is either in the form of a homogeneous dense karyosome, or it proceeds to assume this condition. A number of spaces appear in the karyosome, giving rise to a coarse network. This network becomes a fine structure with enlarged nodes, the latter becoming definite chromatin bodies. The network is in direct communication with the nuclear membrane. In the next step, both nuclear membrane and achromatic network are lost and the chromatin bodies, about sixteen in number, lie apparently free in the cytoplasm. They become dumbbell shaped and divide, giving rise to about thirty-two daughter chromatin bodies. These either diminish rapidly in size, while an achromatic matrix replaces them, or move apart in two groups and then give place to the matrix. The latter becomes the karyosome of the next cycle.

We have reason to believe there is an alternation of the sexual with the asexual generation in this animal. In several carefully studied cases, one generation is present almost to the exclusion of the other. Associated with this condition is another which lends support to the theory of alternation of generations. Schizonts, microgametocytes, and macrogametocytes which develop from merozoites that are associated with zygocysts, are markedly different in structure from these same types when they grow from merozoites that are associated with gametocytes, gamet cysts and gamets, *i. e.,* sexual stages. Moreover, the last-named merozoites are produced by schizonts incapable of dividing more than once or twice, while the first-mentioned merozoites are the progeny of very prolific schizonts. It has been convenient to distinguish the schizonts, microgametocytes and macrogametocytes of the prolific type as "primary," and the others as "secondary" individuals.

Blackhead, a Coccidial Disease of Turkeys: Leon J. Cole, Yale University, and Philip B. Hadley, Brown University.

Variation, Correlation and Growth in Paramecium: H. S. Jennings, Johns Hopkins University.

Sexual Reproduction in Amœba: M. M. Metcalf.

Effects of Alcohol on the Division-Rate of Infusoria: Lorande Loss Woodruff, Yale University.

The experiments summarized were conducted for considerable periods on two species of protozoa, *Paramecium* and *Stylonychia,* whose status in the life-cycle was known through long cultures, and on a sufficiently large number of individuals to afford reliable averages. It is believed, therefore, that the results obtained afford clear evidence of the general effect of alcohol on the division-rate and, therefore, on the metabolism of the organisms studied.

The evidence thus brought forward shows clearly that:

1. Minute doses of alcohol (1/2,500) will decrease the rate of division at one period of the life-cycle, and increase it at another period of the life-cycle.

2. When alcohol (1/2,500) increases the division-rate, the effect is not continuous, but gradually diminishes, and finally the rate of division falls below that of the control series and remains there.

3. An increase (doubling) of the amount of alcohol administered, however, will again cause a more rapid cell division for a limited period, but again this effect is not constant and the rate of division falls below the control. Up to the present time (December 26, 1907) the alcohol has been increased in amount (doubled) three times, always with the same result.

4. Treatment with alcohol lowers the resistance of the organisms to copper sulphate.

The Acclimatization of Stentor to Alcohol: J. FRANK DANIEL, Johns Hopkins University.

Solutions of alcohol above 4 per cent. were found to be early destructive of the protoplasm of *Stentor cæruleus*. In a strength of 1 per cent. or lower, however, the animal lived without apparent injury.

At the end of four days stentors kept in a weak solution had so adjusted themselves as to be able to live in a slightly stronger percentage; further, when killed in a strength of 6 per cent. they gave an average resistance period of twice the control value.

By rearing these ciliates in a weak solution of alcohol plus water of very great purity the factor of food may be eliminated. In such a medium they gained markedly in resistance, thus demonstrating that the lengthened period of resistance was due to the direct effect of the alcohol upon the protoplasm and not to an indirect effect upon the food conditions of the culture.

In solutions weaker than 0.4 per cent. no acclimatization was indicated until after the second day. Those kept in a constant strength of either 0.5 per cent. or 1 per cent., however, showed a clear adjustment at the end of the first day, as, for example, reared in 0.5 per cent. and tested in 6 per cent., average resistance 127 seconds, control value 99 seconds; in 1 per cent., 166 seconds, with a control of 120 seconds. In all cases there was a noticeable increase on either the fourth or the fifth day which marked the maximum of resistance for the series. Following this maximum there was a gradual decline, the cause for which is, as yet, undetermined.

Inheritance in Protozoa: H. S. JENNINGS, Johns Hopkins University.

Some Maturation Stages of the Mouse Egg: J. A. LONG.

E. L. Mark presented some of the conclusions reached by Mr. J. A. Long—a student in Harvard University—especially as to the number of chromosomes. It was imagined a year ago that possibly the number found by Sobotta and confirmed by Kirkham (twenty-four somatic, or twelve reduced) differed from the number counted by Tafani and the author (twenty, reduced) because different breeds or strains of mice actually presented different conditions in this respect. But the courtesy of Professor Coe in loaning some of Dr. Kirkham's preparations for study has led to the belief that differences in the number of chromosomes counted is due rather to the complications of form and grouping presented by the chromosomes than to any difference in the actual number of them.

A critical study of a large number of preparations—between five hundred and a thousand—has shown that, while the chromosomes present a variety of forms at different stages, they are really—as might

have been expected—(1) in the first maturation spindle tetrads, of which there are only twenty present; and (2) in the second maturation spindle dyads. Each dyad is, of course, composed of two monads, but the monads composing a dyad are often deeply constricted, each having a marked dumb-bell shape, so that the whole dyad simulates a tetrad. Since all dyads do not necessarily show this dumb-bell condition of their component monads, the counting is rendered difficult; but the recognition of the possibility of this condition is essential to a satisfactory counting of the chromosomes. These the author maintains are twenty, not twenty-four. Preparations showing the conditions described and illustrated on the blackboard were shown.

The author also is of opinion that the first polar cell gradually atrophies, and by gradual diminution in size finally disappears.

The Maturation of the Egg of the Rat: W. R. Coe, Yale University.

The eggs both of the common brown rat and its albinic variety have been studied in numerous preparations, many of which were made by Dr. W. B. Kirkham. In the formation of the polar bodies, the eggs of the rat agree closely with those of the mouse, the development of which have recently become well known by the publication during the past year of the researches of Kirkham and of Lams and Doorme. As in the case of the mouse and most other mammals which have been studied, the egg of the rat invariably forms two polar bodies, the first of which is produced in the ovary, while the second is formed in the Fallopian tube immediately after the entrance of the spermatozoon into the egg. At the time of ovulation the egg has therefore already formed its first polar body, and the second polar spindle has become fully developed. The entrance of the spermatozoon stimulates the egg cell, and the second polar body is immediately extruded. Eggs which have formed the first polar body, but which for some reason fail to be discharged from the ovary at the time of ovulation, degenerate and eventually break up into fragments, simulating an irregular, abnormal cleavage. These degenerative changes are brought about, at least in part, by the abnormal activities of the previously formed second polar spindle.

The first polar spindle is easily distinguished from the second by the nature of the chromosomes, the former containing, as Kirkham has described for the mouse egg, tetrads which differ considerably in size, and which often split precociously into dyads, while the latter contains either dyads or the separated and often rodlike univalent chromosomes. Both spindles may show at their poles one to three or more dark granules, usually of irregular shape, which may be looked upon as centrioles.

As in the mouse, also, the second polar body can usually be distinguished from the first by the arrangement of the chromosomes. In the first polar body these chromosomes are usually scattered irregularly, while in the second polar body they are commonly fused together into a dense nuclear mass even before the complete separation of the polar body from the egg substance.

The egg of the rat, furthermore, resembles that of the mouse and differs from most other mammalian eggs in that in the vast majority of cases the first polar body has disappeared before the egg reaches the Fallopian tube. Eggs in the course of fertilization and cleavage, therefore, are usually accompanied by but a single polar body, namely, the second.

The entire substance of the spermatozoon enters the egg, the head quickly forming

a typical sperm nucleus, while the tail stains intensely and occupies a position close beneath the vitelline membrane for more than half the circumference of the egg.

A Contribution Towards an Experimental Analysis of the Karyokinetic Figure: FRANK R. LILLIE, University of Chicago. (To be published in the proceedings of the Central Branch.)

The Accessory Chromosome of Anasa Tristis: EDMUND B. WILSON, Columbia University.

Certain contradictions in the literature have led the author during the past year to make an exhaustive re-examination of the history of the accessory chromosome in *Anasa tristis,* paying particular attention to a comparison of sections, smears and material in the unfixed, unstained condition. These various methods give thoroughly consistent results, which appear with an elementary clearness that excludes all obscurity of doubt. All the essential facts in this species are as the author previously described them, and are uniformly and consistently as follows:

In *Anasa tristis* the fundamental somatic number is in the male 21 and in the female 22. During the growth period of the spermatocytes the unpaired or accessory chromosome retains the form of a condensed chromosome-nucleolus until the early prophases of the first division. It then elongates to form a longitudinally split rod, again condenses to form the eccentric chromosome of the first division, and divides equationally in this division. In the second division the grouping of the chromosomes usually changes, and an eccentric position is no longer characteristic of the odd chromosome. During the division this chromosome passes undivided to one pole, which receives eleven chromosomes, while the other pole receives ten. The spermatozoa are, therefore, of two classes, equal in number; and comparison of the male and female groups shows that the eleven-chromosome class must be female-producing, the ten-chromosome class male-producing. These results have in the meantime been independently confirmed by a number of other cytologists.

Abnormal Development of Frog Embryos as a Result of Treatment of Ova and Sperm with Roentgen Rays: J. H. MCGREGOR, Columbia University.

Wood-frogs (*Rana sylvatica*) were taken at the breeding season when about to discharge the sexual products and exposed to moderately strong Roentgen radiations for periods varying from twenty minutes to two hours, after which each one was placed in a dish of water with a frog of the other sex. In the series of experiments were cases where both were exposed, and others where only the male or only the female was exposed. In all cases the frogs paired promptly and all the females deposited eggs.

The study of the development of the eggs yielded some interesting results, which may be stated in very general terms as follows: Where only the female was exposed, the male being normal, all the eggs developed, about 5 per cent. of them developing various abnormalities. Where the female was normal, the male only exposed; only about 5 per cent. of the eggs were fertilized and of these the majority developed various deformities during early stages. When both were exposed the result was practically the same as when the male alone was treated.

The deformities were of various types, among which may be noted bladder-like distension of cœlom, tumor-like proliferations on various parts of the body, double tails, and atrophy of certain parts of the brain. Of two larvæ which lived five

weeks one had no eyes, the other only one. At the time of exposure of the frogs the eggs were probably in the first polar-body stage, the spermatozoa practically ripe. The cytological study of the material has not been completed.

The Effects of a Centrifugal Force on the Eggs of Cumingia: T. H. Morgan, Columbia University.

Rapid rotation drives the yolk to one pole of the egg, the nucleoplasm to the opposite. The polar spindle lies in the protoplasm of the middle zone of the egg, and its orientation is little affected by the centrifuging. The polar bodies may be given off at any point of the surface. The cleavage is like that of the normal egg in all respects, even when all the yolk lies in the smaller of the first two cells. This shows that the determinate type of cleavage is not affected by the distribution of the yolk, nucleoplasm or pigment, or by the stratification. In this last respect the results are different from those in the centrifuged eggs of the sea urchin, because, while in *Cumingia* the position of the nuclear spindle is not changed by the centrifuging, in the sea urchin the female pronucleus is driven into the axis of stratification. In general, a resting nucleus may be forced to the lighter pole of the cell, owing to the presence in the nucleus of nuclear sap, but the chromosomes and the spindle are more difficult to move, since they have nearly the same specific gravity as the cytoplasm. When they move they do so as a whole, which shows that the spindle figure when present is a definite structure. Embryos develop from the stratified eggs of *Cumingia,* but whether normal embryos develop for all possible distributions of the different materials of the egg has not as yet been positively determined.

Degeneration in its Relation to Classification: Charles B. Wilson.

On examining the writings of those investigators who have dealt with the group of copepods it is found that nearly every part of the copepod's body has been used by one or another as a basis of classification. There are nearly as many different schemes of classification as there are authors. Is there anything, aside from the inherent excellence of the writings themselves, which will assist us in deciding their scientific merit? Can we say that any one of the schemes is more rational and logical than the others?

In endeavoring to answer this question it seems to me that we must take into account first of all the fact that considerably more than half of the group live as parasites or semi-parasites on other animals. One of the most common results of parasitism is degeneration, in consequence of which an organ loses its function, then its size and shape, and finally may entirely disappear. No one questions for a moment the influence which development should have upon classification; any scheme which left development out of consideration would be branded at once as worthless. Why should not degeneration, which is the reversal of development, prove of equal value, especially in a group where it is so finely illustrated as in the copepods?

There are several things which strongly recommend it. It proceeds even more slowly than development, so that we are enabled to follow every step in the process, and almost never need be at a loss. In development it often happens that several new organs appear at a single moult about equally advanced, and it is very difficult to decide which are of the greatest value from a systematic point of view. The newly hatched nauplius has three pairs of appendages, the first and second antennæ and

the mandibles. At the moult from the nauplius into the metanauplius we find in addition two pairs of maxillæ, often two pairs of maxillipeds, and sometimes one or more pairs of swimming legs. To which of the three nauplius appendages should preference be given, and if the mouth-parts be chosen as a basis of classification which of them possesses the greater value?

Degeneration quietly eliminates these appendages one by one; why may not its testimony be taken when the case is so difficult of decision otherwise?

Again development requires that we obtain the eggs and rear the young through successive stages; any one who has tried this on the copepods realizes how very difficult it is. And even when accomplished, many of the conditions are of necessity abnormal, and in consequence might produce abnormal results.

Degeneration, on the other hand, is produced upon the adults in their native habitat and surrounded by their usual conditions. We can obtain and study the results with comparative ease; we are not obliged to reproduce any of the conditions.

Degeneration thus determines in the copepods which of the appendages are the most stable and the least susceptible to change; it selects the first antennæ from among the nauplius appendages and of the mouth-parts the mandibles as the most stable and the first maxillæ as the least so. Consequently that classification is the best which is the most fully based on these stable elements. We find such an one originally proposed by Thorell in 1861, corrected by Claus in 1862, by Gerstaecker in 1881, and finally by Canu in 1892.

Wound-reparation and Polarity in Tentacles of Actinians: HERBERT W. RAND, Harvard University.

At the Bermuda Biological Station for Research, in the summer of 1907, I studied the reactions resulting from cutting the tentacles of certain large actinians (*Condylactis* and *Aiptasia*). If a piece of tentacle is removed by a transverse cut, within a few minutes the open cut end of the stump is closed by a concentric inbending of the wall of the tentacle. The newly closed end is hemispherical except for the presence of a small cylindrical nipple-like projection at its center. This closure is effected by contraction of the circular muscle fibers. The "nipple" results from extreme contraction of the circular fibers immediately proximad of the plane of cutting. Within a day or two after the cutting there ensues a rearrangement of the elements of the tissues in the vicinity of the cut, whereby results a permanent closure which is not dependent upon muscular contraction. Thus, the reparation of the wound exhibits two phases. A temporary repair is effected by active muscular contraction pending the slower reorganization of the tissues by which the muscular tension at the cut end is relieved and a permanent repair established.

The closing of a distal cut end and the formation of a "nipple" in the manner described above take place in a tentacle after it has been severed from the column. This fact can not be interpreted as indicating autonomy of fragments of the organism. The piece of tentacle is a fragment of the actinian, but it is not a fragment of the actinian organization because in it are embodied the essential features of the entire organization.

When an excised tentacle is cut transversely into several pieces, each piece shows a definite polarity in that its two ends assume distinctly different forms. Thus, in any transverse zone of the tentacle two modes of response to transverse cutting are potentially present. In the event of transection either one or the other mode

of behavior will be exhibited, depending upon whether that zone comes to lie at a proximal or a distal cut end. No structural basis for this polarity has been found.

An Experimental Study of the Rate of Regeneration in Cassiopea xamachana: Chas. R. Stockard, Cornell Medical School.

When a peripheral ring of tissue is removed from the disc of *Cassiopea* the cut surface promptly begins to regenerate a new rim. The nearer the cut is made to the center of the medusa-disc, up to a certain limit, the faster will the resulting regeneration take place.

Regeneration from variously shaped cut surfaces proceeds in exactly the same manner as has been described in experiments on the fins of fishes. Thus the same principles of regeneration seem to apply to the formation of new tissue from appendages and the true body surface of animals. Further, a common principle or law regulating the rates of regeneration may probably run through the animal kingdom, since forms at almost opposite ends of the series, the fish and medusa, regenerate in a similar manner.

A bias-cut strip of the entire periphery of the medusa-disc and the remaining central portion gives a preparation in which the influences due to the level of the cut may be contrasted with those due to degree of injury. Influences due to the level are alone indicated by the ensuing growth. Regeneration in either direction, towards the periphery or towards the disc-center, proceeds at approximately the same rate from the same level.

Ring preparations made from these medusæ are splendid objects for the study of the influences due to functional activity. Portions of the ring which are entirely at rest throughout the experiments regenerate tissue at the same rate as other parts which pulsate normally. Functional activity shows no influence over the rate of regeneration in this form.

Medusæ having one or more of their eight oral-arms removed regenerate these arms at irregular rates which are not closely associated with the degree of injury. Medusæ injured to the same degree often show greater variations in their specific rates of regeneration than are found among individuals injured to different degrees. A medusa with several of its oral-arms cut away in a similar manner may regenerate the individual arms at rates differing as much as do the average rates shown among many medusæ injured to various degrees.

The influences of changed physical conditions on the rate of regeneration were tested, as well as the effects due to excesses of Na, K, Ca and Mg in the sea-water.

Regeneration of Peripheral Nerves: Ross G. Harrison, Yale University.

The nerves of one side of the tail of larvæ of *Rana sylvatica*, 2–2.5 cm. long, were cut with fine scissors just beyond the point of emergence from between the myotomes. The processes of degeneration and regeneration were then observed from day to day in one and the same nerve in the living specimen. The degenerative processes take place very rapidly. In less than twenty-four hours the medullary sheath is completely disintegrated beyond the lesion and for a very short distance central to it. In the axis-cylinder of both the medullated and the non-medullated nerves the signs of degeneration are less marked, though unmistakable, and are noticeable in even the finest and most remote twigs. The Schwann cells become less regularly spindle shaped, with a somewhat humpy surface, and do not adhere

so closely to the axis-cylinder. They are also found to contain a few granules. After one or two days it is found that the two cut ends of many of the nerves have united together by a protoplasmic bridge, and in such cases the degeneration of the peripheral part of the axis-cylinder is immediately arrested, indicating that in these larvæ a primary healing of nerve fibers is possible. The medullary sheath is not rehabilitated immediately and the process of re-formation of this structure resembles that of its initial development. When the peripheral portion of a nerve fails to unite with a central stump, degeneration continues and ultimately the nerve disappears, the finer twigs disintegrating first. When a central stump fails to unite with a peripheral end, regeneration by a comparatively slow process, in a centrifugal direction, takes place. There is no indication whatever of any power of "auto-regeneration" in the nerves whose connection with the central end remains severed.

Some Singular Cases of Regeneration and Increase in a Deep-sea Coral by Agamic Endogenesis: ADDISON E. VERRILL, Yale University.

The paper considered a cornucopia-shaped simple deep-sea coral, dredged by the U. S. Fish Commission in 57 to 179 fathoms, off the eastern coast of the United States. It was first described by Pourtales as *Parasmilia Lymani* (now *Dasmosmilia*). The walls of this coral are extremely thin and fragile, while the radial septa are strong. Therefore, when injured, it easily splits lengthwise into wedge-shaped fragments. Entire adult specimens are rarely taken. The larger fishes and crabs, living in deep water, are responsible for the breakages. Each fragment, even when very small, has the power to produce one or more buds on its inner surface, from the tissues covering the septa. If a single bud starts near the distal edge of a large fragment, it ultimately grows in such a way as to blend on the outer side with the wall and septa of the fragment, so as to appear, sometimes, like a mere repair of damages, with regulation of parts. But when the bud starts farther from the edge of the fragment, it may grow up vertically from it, later using it only as an object for its basal attachment. Several buds, sometimes as many as 6 to 8, may arise from the inner surface of a large fragment, growing up vertically or obliquely. If several buds start close together, they soon come in contact at their edges, as they grow larger, and graft themselves together, thus giving rise to bilobed or trilobed calicles in the mature corals, but when the buds stand singly, the calicles are circular. About one hundred specimens were studied, and of these there were very few that did not originate as buds, showing the fragment of the parent calicle still attached to the base.

In this coral there is, therefore, a gradual transition from the mere repair of an injury to the border of the calicle (or regeneration of parts) to complete and perfect buds. These various forms were illustrated by lantern slides.

Some Results of a Biometrical Study of Egg Production in the Domestic Fowl: RAYMOND PEARL and F. M. SURFACE.

This study is based on the statistics of egg production which have accumulated during the past ten years at the Maine Agricultural Experiment Station. During this period an exact trap nest record has been kept of the entire egg production of all laying birds during their pullet year. These records are of unique value in the analysis of the general problem of fecundity, since they furnish data on a single isolated factor—ovulation. The data here

discussed are from a single breed of fowls, Barred Plymouth Rocks. They are based on returns from several thousand hens. It is hoped that a detailed account of the results will be published shortly.

Variation in Annual Egg Production.—If frequency distributions of individual variation in total annual egg production be made, they are found: (1) to be unimodal; (2) to exhibit negative skewness in all but a few cases. In these cases the variation curve is symmetrical; (3) to conform to Pearson's Type I curve when unsymmetrical, and to his Type II curve when symmetrical: (4) to exhibit a high relative degree of variation (coefficient of variation = 35 per cent. ca.).

Comparative Distribution of Birds and of Eggs produced.—In consequence of the skewness of the variation curves it results that 50 per cent. of the total number of birds produce from 60 to 76 per cent. of the total number of eggs. This is of practical consequence in breeding, since it means that a random sample of eggs will not represent a random sample of the birds which produced them, but instead will include an unduly large proportion of heavy layers.

Monthly Distribution of Egg Production.—The maximum mean egg production is in March or April. Secondary maxima occur in January, June and September. These maxima are entirely independent of the total egg production, appearing in the records of the lowest as well as the highest egg producers. If the difference between the heaviest and lightest layers in respect to the mean egg production for each month in the year be taken, it is found to be smallest in March, April and May, largest in the late summer and early autumn months. The individual variation in egg production (measured either by standard deviation or coefficient of variation) is greatest in those months when the mean production is least, and *vice versa*. There is no sensible correlation between the egg production in the pullet year and that in the second laying year.

Some Effects of Differences of Temperature and Humidity upon the Post-natal Development of the Mouse: F. B. Sumner.

White mice which were transferred at the age of two to four days to two rooms having mean temperatures of about 45° and 75° F. respectively (the relative humidity being about twice as great in the former as in the latter) were found to exhibit great differences in tail length when measured at the age of 42 days. Although the mean weight of those kept in the warm room (51 individuals) was less than 6/10 gm. greater than that of the cold room lot (44 individuals), the mean tail length was 69.3 mm. in one case, and 52 mm. in the other, *i. e.*, there was a difference of over 33 per cent. Moreover, the shortest tail in the warm-room lot was longer than the longest tail in the cold-room lot.

In a previous experiment, in the course of which 20 mice in each lot were subjected to conditions similar to those stated above for a period of from 83 to 106 days, commencing with the fourth week after birth, the difference in tail length was 7.1 mm., or 11 per cent. of the tail length of the cold-room lot. On the other hand, the mean weight and the mean body length (distance from snout to anus) in the two lots was almost identical. In this experiment, the males of the cold-room series (13 individuals) were found to have an average of 305 hairs in a given unit of skin surface (2 disks, each 1.5 mm. in diameter), while those of the warm-room lot had, on the average, 267 hairs in the same area of skin. The variability in each case

was so great, however, and the number of individuals so small, that these figures may have no significance. More accurate measurements, based on a far greater number of individuals, are to be made in the near future.

Such an adaptive response as an increase in the density of the coat of hair, following a transfer to a colder environment, is popularly believed to occur in nature. On the other hand, an abridgment in tail length, as a result of cold, has been reported in the case of cats. Whether or not such somatic changes are inherited, or better, whether similar changes reappear in the offspring, is a subject under investigation by the author.

Physical Identity in Duplicate Twins: H. H. WILDER, Smith College.

Introduction.—Review of the morphology of the epidermic patterns in man, as brought out by the work of previous years, chiefly that of Inez Whipple [Wilder]. In the foot of a typical pentadactylous mammal there are eleven walking pads, surrounded by folds of skin, arranged in such a manner that the pads are embraced by the prolongations of two, three or four triradii. This formation, which is a high relief in walking mammals, becomes reduced to an approximately plane surface in primates, *i. e.,* a picture of the former relief. This loss of functional significance has, however, resulted in a more or less complete reduction of the individual features, and thus the patterns assumed by the epidermic ridges in man represent various degrees of reduction of the fundamental plan and are individually extremely variable. They also normally show little tendency to a bilateral symmetry, so that the patterns on the two hands or the two feet of a given individual are usually quite different.

Exhibition of the Prints of a Set of Twins.—[Set No. XX. of the author's collection.] These are the prints of two small boys in Portland, Me., Henry and Bernard. They are first of all remarkable in that the hands show the eleven typical patterns complete, a case so rare that it does not occur otherwise in a collection of the palm prints of about 450 individuals, including very varied human races. Aside from a striking resemblance between the four sets of members the prints show the characteristics which are usually to be noted in cases of true duplicates, viz:

(*a*) Bilaterality, so that all four palms have virtually the same pattern. The same is true of the soles.

(*b*) A remarkable reversal of the apical or finger-pattern of the index finger. The right pattern of one is an ulnar loop, while that of the other is radial; on the left hand the pattern of the first is radial while that of the other is ulnar. This condition, while not always found in twins which seem to be duplicate, has been observed in one side at least in more than half of the cases.

Conclusions.—The practical impossibility of finding so close a correspondence in any two children normally related, together with the other conditions noted, lead to the inevitable conclusion that in such twins we have a condition from the germ on that is unlike that which obtains in normal individuals. If we accept the most probable theory to account for the origin of such twins, viz., their origin from a single egg, it then follows that the general form of the epidermic patterns is predetermined in the germ immediately after fertilization, in short that in duplicate twins nature tries for us the important experiment of making two individuals out of the same germ-plasm and that the study of their palm and sole markings shows better than any other known features how great is the resem-

blance. Since, by a comparison of the prints, it may be seen that the resemblance is confined to the general patterns while there is no especial resemblance in the individual ridges (Galton's "minutiæ") we arrive at what may be called the limit of germinal control, *i. e.*, the point where the directive force felt in the development ceases to act, leaving further details to other forces.

Heredity in Epidermic Markings of Palms and Soles ("Friction-skin").—In a set of sole prints of a family, including three generations, the inheritance of a definite configuration over certain definite areas was followed by means of distinctive colors. In these prints a marked degree of hereditary influence was shown, especially in the inheritance of a "calcar pattern," one of the rarest features in the human foot.

The Four Inseparable Factors of Evolution, Theory of their Distinct and Combined Action in the Transformation of the Titanotheres, an Extinct Family of Hoofed Animals in the Order Perissodactyla: Henry Fairfield Osborn, Columbia University. (Published in full in Science, January 24, 1908.)

When do Variations attain Selection Value?: Bashford Dean, Columbia University.

One of the major criticisms of Darwinian natural selection showed that small fluctuating variations were not of actual value in the struggle for survival: accordingly, they would not be expected to accumulate in the direction of pronounced utility. And it is notably this criticism which lies at the base of various neo-Darwinian explanations. In the present contribution stress is laid upon the fact that variations may attain selection value without an accumulation of small and less useful stages. The stages in such cases occur, it is true, *i. e.*, as small fluctuating variations, rarely appearing suddenly, but they are meaningless in terms of selection.

This point of view was explained by a series of analogies, in which there was no ground to question the non-utility of the stages of cumulation. For the end result itself, although as highly complex as many of those which are granted selection value, could have had no significance in the struggle for survival.

Numerous analogies of this kind were cited: resemblances to human face in the pupæ of *Feniseca tarquineus* and of *Sphalgis s-signata,* on back of death's head moths, in Taira crab, on "ear bone" of whale, in seed-capsule of *Antirrhinum:* resemblances of tree hoppers to birds, of desiccation lines on seeds to ideographs, of the supraoccipital of an Indian goat to the face of *Entellus,* of the rabbit's sphenoid to a fox's head.

If such remarkably complicated resemblances could be attained by non-useful variations, it follows that some, if not many cases whose value has been debated (protective coloration, mimicry) may have had a similar accidental and meaningless origin.

Inheritance in Canaries: C. B. Davenport, Carnegie Station for Experimental Evolution, Cold Spring Harbor, N. Y.

Crest is a typical Mendelian dominant over plain head. Plain-headed canaries do not throw crests; and among crested birds of the second or later hybrid generation some may be obtained that produce only crested offspring. Baldness is a typical recessive to full head feathering. In the plumage color the yellow form is derived from the ancestral "green" canary by a dropping out of black pigment. The yellow canary carries, however, a mottling factor, so that in F_1 the green $\times$ yellow gives offspring that are yellow mottled

with black, forming "green" patches of variable extent. The behavior of the plumage color in subsequent generations supports the view that the gametic formula of the "green" canary is: *Nm* [*i. e.*, black (nigrum) pigment present, mottling absent] and that of the yellow canary is *nM* [*i. e.*, black pigment absent; mottling factor present]. Hybrids between the goldfinch and canary show, in the same way, the presence of the mottling factor; but the dark patches are usually extensive. The "reversionary" character of the hybrid is due to the original pattern of the wild canary that lies latent—because of lack of pigment, in the yellow canary.

The Sense of Taste in Fishes: G. H. PARKER, Harvard University.

In the common horn pout (*Amiurius nebulosus*) taste buds occur not only in the mouth and on the barbules but also over almost the whole external surface. Those on the exterior of the fish are innervated by branches of the seventh nerve. Horn-pouts will snap at a bait when it is presented to the flank of the body as well as when it is close to the mouth. The exterior of the body is also sensitive to sour, saline, and alkaline solutions, the head being more sensitive to these solutions than the trunk. In horn-pouts in which the branch of the seventh nerve distributed to the skin of the trunk has been cut, thus rendering inoperative the taste buds of the trunk, there is no longer a response to bait brought near the trunk, though the same bait is greedily taken when presented to the mouth. Such animals, however, retain their full sensitiveness to sour, saline, and alkaline solutions when applied to the skin of the trunk. That the loss of response to a bait when presented to the flank of a horn-pout after the severance of the seventh nerve is not due to shock is shown by the fact that this sensitiveness is retained by fishes in which the large lateral-line branch of the tenth nerve has been cut. After cutting the lateral branches of both the seventh and tenth nerves the only sensory nerves left intact on the flanks of the body are the branches from the spinal nerves. Since fishes in this condition respond to sour, saline and alkaline solutions, it follows that these solutions must stimulate the terminals of the spinal nerves and that these nerves must be regarded, therefore, as chemical in function, though they are not primarily concerned in the response to bait. In horn-pouts the posterior half of whose spinal cord has been destroyed but whose seventh nerve is intact, there is no response when sour, saline, and alkaline solutions, and bait are applied to the flanks near the tail. The absence of response to bait in this experiment is due, I believe, to the loss of the motor mechanism of the cord whereby the fish turns to snap at the bait and not to the loss of the spinal sensory fibers. The loss of these fibers would account for the absence of response to sour, saline and alkaline solutions. From these experiments it is to be concluded that the sense of taste in horn-pouts is complex and involves not only the seventh nerve, but also the spinal nerves.

The Organ of Claus in the Copepod Eucalanus elongatus Dana: C. O. ESTERLY.

E. L. Mark gave an account of some of the principal points regarding "The Organ of Claus in the Copepod *Eucalanus elongatus* Dana" which have been discovered by Dr. C. O. Esterly. There is a pair of these organs, and they are imbedded in the front part of the brain near its ventral surface. Claus, who discovered the organs in *E. attenuatus* Dana, thought they were otocysts. Esterly shows that they are not vesicular, but are solid, each

composed of two cells, and that their histological conditions are so nearly identical with those of the median eye, composed of three ocelli, that they must be regarded as organs of vision rather than of audition. The retinal cells of the median eye and of these organs both present peculiar basal plates, and the cytoplasm of the cells shows a marked but fine striation, which Hesse has erroneously regarded as homologous with the "Stiftchensaum" which he discovered in the eyes of many invertebrates. Esterly regards this striation as the expression of a structural condition due to the secretive activity of the retinal cells in producing the basal plates. The "Binnenkörperchen" of Hesse, or phaosomes, are present in the organ of Claus as well as in the ocelli, and are thought to be of importance in light reception.

There are ten retinal cells in the ventral ocellus, and nine in each of the lateral ocelli composing the median eye. From the basal-plate end of each cell emerges a single nerve fiber, these twenty-eight nerve fibers constituting the single optic nerve of the median eye. Two nerves emerge from each organ of Claus, one from that surface of each retinal cell which is opposite its basal plate. In this particular the organ of Claus differs from the ocelli, the former being eyes of the inverted type, whereas the ocelli are—contrary to the opinion of Hesse—not inverted. The neurofibrillæ appear to end in the retinal cells in beaded fibers having terminal club-shaped enlargements, which often have an intimate relation to the phaosomes. This suggests a possible functional relation between the two.

Six plates of original drawings by the author and reproductions of them by the photogravure process (A. W. Elson & Co.), together with some of the preparations, were exhibited.

The Luminous Organ of a New Species of Anomalops: Ulric Dahlgren, Princeton University.

The fish was taken by the writer in moderately deep water off the north coast of Jamaica, B. W. I., in March of last year. It will be described and named by Mr. C. F. Silvester, of the Princeton museum.

The fish shows several whitish spots on parts of the body and these spots may have a luminous function. This could not be determined.

The main luminous organ consists of two large "photophores" placed one under each eye. The photophore lies close to the eyeball and may be said to be a part of the under lid. When first seen it gives the impression of being a foreign substance in the eye and the native fisherman would not believe that it was not a worm. The length of the organ was about the diameter of the eye and it was oval in form. Its color was cream white and the presence of a large blood supply directly on the surface was noticeable in the form of a reticulum of red lines on what was apparently the outer surface.

The entire organ was somewhat loosely fixed and could be rotated laterally down under an edge of integument so as to be almost entirely concealed. The part under which it slipped had a thickened edge and could be regarded as a means of suddenly shutting off the light when it was necessary not to show it.

The structure of the organ can be very well made out in a single section taken transversely to the long axis of the animal's body and therefore to the longer axis of the photophore. This shows that the largest mass of the organ consists of a close set and parallel set of simple tubular glands reaching from the outer to the inner surface of the structure. These glands are

lined by a single layer of cubical cells whose distal ends terminate in an indefinite boundary between the substance of the cell and the mass of secretion that fills the lumen of the tubule.

But the secretion mass is not discharged into the water from these tubules. They open into a flat cavity, with enclosed sides, of the single (?) original invagination by which the gland was formed (presuming on the unknown embryology), and it is this thin outer layer of integument that contains the heavy blood supply.

Another system of capillaries is found between the tubules, and is evidently designed to bring a supply of food material within reach of the secreting cells, which are very active as measured by the amount of highly specialized product they secrete. The operation of the organ would appear to be as follows:

The secreting cells discharge the elaborated material (which is a "leuciferase") into the lumen of the tubular gland, which carries it up and passes it out into the outer flat spaces in contact with the inner side of the external integument. Here it is used, being consumed by the oxygen that is brought to it in the heavy blood supply of this integument. Its waste products of combustion must also be carried away by this blood and are probably extracted by the kidneys, along with the waste matter from the other body tissues.

Since the whole structure was probably derived from the stratified epithelium of the outer body surface, the secreting epithelium must be looked upon as the specialized basal layer of this invaginated region.

The whole gland lies on a layer of connective tissue which is modified to reflect light. This reflector is very efficient and when a mounted section is laid on a piece of black velvet, it alone shines out as a white line. Still outside of the reflector is found a layer of intensly black pigment. At its upper edge, this is useful in protecting the eye from the organ's light.

The thickened edge of the lower "lid" consists of an integument covering a mass of cells which appear to be nerve cells. This is probably some ganglion which is used to control the production of light.

The Poison Glands of Bufo agua: C. L. BRISTOL and G. W. BARTELMEZ.

The material was collected in Bermuda at the New York University Biological Station, the original habitat being South America. This toad has had the reputation of being poisonous to mammals, and we finally verified instances of poisoning. The poison acts only on a mucous membrane, and produces results similar to curari.

The poison glands are found only on the upper surface of the body, while mucus glands are found all over the skin, and are crowded together in large parotoid "glands" behind each ear. They are much larger than the mucus glands and extend deep down into the compact corium layer. They are surrounded by a thin layer of loose connective tissue which contains nerve fibers and a dense network of capillaries. There is an almost continuous layer of smooth muscle fibers about the gland. The cells of the glandular epithelium develop to an enormous size, and when they mature they disintegrate, their entire plasm becoming the secretion, so that when a poison gland has reached its full development it is simply a reservoir of poison. When the poison is discharged the remains of the gland are resorbed, and at the same time one of the five or six undeveloped glands, grouped around the mouth of the functioning gland grows down alongside the remains of the discharged gland, pushing it aside to occupy its former place.

(To be concluded)